

HUMAN BODY SYSTEMS / HOMEOSTASIS
Pre-AP Seventh Grade Science
2011-2012

Description

There are many different types of cells in the human body, none of which function properly alone. Cells group together in the body to form tissues with specialized functions. Organs are structures that contain at least two different types of tissue that work together for a common purpose. Organ systems are composed of two or more different organs that work together to perform more complex functions. There are ten major organ systems in the human body: circulatory, respiratory, skeletal, muscular, digestive, excretory, reproductive, integumentary, nervous, and endocrine. These systems don't work independently of each other. Instead, their processes are integrated to the extent that if one system fails, the other systems could not continue to function. Each system depends on the others, either directly or indirectly, to keep the body functioning normally. Homeostasis is an organism's ability to maintain a normal, stable state of healthy functioning, including such things as regulation of temperature, blood flow, oxygen-carbon dioxide exchange, elimination of waste products, use of nutrients, and immune system responses. Essentially, homeostasis is the organism's effort to maintain optimal health and proper balance. Homeostasis is affected by many stimuli, both external and internal, including heat, cold, hydration, nutrition, digestion and elimination, among others. As a result of these different types of stimuli, the organism produces numerous hormones, chemicals and physiological reactions which trigger body systems to respond in a way that helps the organism maintain homeostasis. Homeostasis occurs at all levels of organization, from the cell to the organ system. In addition, while plants may not be able to move or process information the way that animals do, it is also possible for them to respond to environmental stimuli in order to maintain homeostasis. Sometimes the response will involve the movement of a part of the plant, and often the response happens at the cellular level.

Connections

The human organism may be described in terms of levels of organization, from the cell to the organ system. There are ten major organ systems in the body. The functioning of these systems is based on physical and chemical changes, and all organ systems and body process are designed to aid the body in reaching its optimal level of functioning, or homeostasis. Other organisms, such as plants, also have physiological processes that help the organism maintain optimal conditions. In both animals and plants, active and passive transport of materials into and out of the cell as well as hormonal responses to internal and external stimuli are processes that lead toward homeostasis.

Enduring Understandings

1. The skeletal system provides support for the body, protects internal organs, and provides attachment sites for the organs. Some major organs include bones, cartilage, tendons and ligaments.
2. Muscles work in pairs to move bones and provide the organism with the ability to move. Muscles also control the movement of materials through some organs, such as the stomach, intestines, heart and circulatory system. (Some major organs include skeletal muscles and smooth muscles throughout the body.) [Note: the sentences in parentheses in the following E.U.'s are included for completeness and while some coverage of the organs in a system may be necessary to convey full meaning of a system's function, students should not be expected to memorize all of the organs that make up each system.]
3. The circulatory system transports nutrients, gases (such as oxygen and CO₂), hormones and wastes throughout the body. (Some major organs and tissues include heart, blood vessels and blood.)

4. The nervous system relays electrical signals throughout the body in order to direct behavior and movement and control physiological processes such as digestion and circulation. (Some major organs and tissues include the brain, spinal cord and peripheral nerves.)
5. The respiratory system provides gas exchange between the blood and the air taken in from the environment. Primarily, oxygen is transferred into the body and carbon dioxide is expelled from the body. (Some major organs include the nose, trachea, bronchii, alveoli and lungs.)
6. The digestive system breaks down and absorbs nutrients that are necessary for growth and maintenance. (Some major organs include the mouth, esophagus, stomach, small and large intestines.)
7. The excretory system filters out cellular wastes, toxins and excess water or nutrients from the circulatory system. (Some major organs include the kidneys, ureters, bladder and urethra.)
8. The endocrine system relays chemical messages through the body in order to help control physiological processes such as nutrient absorption and growth. (Some major glands include the hypothalamus, pituitary, thyroid, pancreas and adrenal glands, all of which secrete hormones.) A hormone is a chemical released by a cell in one part of the body that sends out messages that affect cells in other parts.
9. The reproductive system manufactures cells that allow reproduction and to ensure continuation of the species. In the male, sperm are created to fertilize egg cells produced in the female. (Some major organs include ovaries, oviducts, uterus, vagina, and mammary glands in the female; testes, prostate, and penis in the male.)
10. Nausea and vomiting are most often caused by viral gastroenteritis, commonly known as the stomach flu. Infections of this type irritate the lining of the stomach, resulting in the forceful expulsion of contents of the stomach and often, the upper part of the small intestine.
11. The immune system destroys and removes invading microbes and viruses from the body. The lymphatic system also removes fat and excess fluids from the blood. Some major organs and tissues include lymph nodes and vessels and white blood cells.
12. Diffusion and osmosis are passive, physical processes during which molecules spread from areas of high concentration to areas of low concentration (concentration gradient) through a semi-permeable membrane. When the molecules are even throughout a space, equilibrium is reached and homeostasis results.
13. In a solution with a higher concentration of solute on the outside of the cell than on the inside (hypertonic), water will move out of the cell by osmosis. Hypertonic solutions result in wilting plants with the cell membrane shrinking inside the cell wall. Animal cells also shrink.
14. In isotonic solutions, water moves back and forth across the membrane by osmosis with no net gain on either side since solute concentrations on both sides of the cell are equal. This is a homeostatic system.
15. Hypotonic solutions have a higher concentration of solute inside of the cell than outside, and thus water moves into the cell by osmosis. Plant cells might bulge in such a solution but not burst due to their rigid cell walls. Contractile vacuoles pump water out of animal cells to prevent them from bursting. Hypertonic solutions have a higher concentration of solute
16. Plant root cells maintain a homeostasis of nutrients drawn from the soil through the roots by a process called active transport. Because a higher concentration of nutrients exists inside the root cells than in the surrounding soil, the plant cell must use ATP energy (released by chemical processes of the cell's mitochondria) to pull more nutrients from the soil.

Essential Questions

1. What is a body system?
2. What are the functions of the different body systems?
3. How many body systems does a human have?
4. How do individual body systems help in maintaining homeostasis?

5. How do body systems work together to maintain homeostasis?
6. What are the signs that an animal's homeostatic processes are out of balance?
7. What is a stimulus/response mechanism?
8. How are hormones related to stimulus/response mechanisms?
9. How are hormones related to homeostasis?
10. What is the difference between osmosis and diffusion?
11. How do osmosis and diffusion help maintain homeostasis?
12. Does homeostasis apply to organisms other than humans?
13. What are the signs that a plant's homeostatic processes are out of balance?
14. What processes help plants maintain homeostasis?

Essential Concepts and Skills

By the end of the unit, the student is expected to:

1. Develop function statements for each human body system: circulatory, respiratory, skeletal, muscular, digestive, excretory, reproductive, integumentary, nervous, and endocrine.
2. Design in-class demonstrations to illustrate at least one specific characteristic of each body system.
3. Classify body processes by body system.
4. Demonstrate human stimulus/response pairs.
5. Construct a flow chart showing human physical responses caused by hormonal responses (internal stimuli).
6. Deduce stimulus/response pairs detected by human senses (external stimuli).
7. Chart human body system responses to bacterial and viral invasions.
8. Assess the effectiveness of human stimulus/response pairs in maintaining homeostasis.
9. Explain how osmosis and diffusion are homeostatic processes.
10. Compare and contrast how hypotonic, hypertonic, and isotonic solutions drive the processes of osmosis and diffusion.
11. Illustrate the differences between phototropism, gravitropism, and thigmotropism.
12. Explain how auxins cause plant responses in the form of tropisms.
13. Describe how tropisms are related to the maintenance of homeostasis in plants.
14. Investigate conditions which cause wilting in plants.

What do students typically have as misconceptions?

1. Students believe the blood in veins is blue.
2. Students believe muscle cells can push and pull.
3. Students believe the small intestine is short; the large intestine is long.
4. Students believe respiration is the same as breathing.
5. The fetus does not need oxygen in the womb.
6. The fetus does not produce waste products in the womb.
7. Solids not used by the body stay in the intestine or travel back to the intestine and leave through the anus.
8. Urine and feces are made up of left over liquids our bodies did not use.

Preconception Survey

1. What do you think homeostasis means? ("*homeo*" means man or human; "*stasis*" means placed, or staying)
2. Why is homeostasis so important to survival of a species?
3. Could you survive if one of your body systems was no longer homeostatic? Explain.

Formative Assessment Items

1. Evaluate voluntary versus involuntary reflexes as a response to an external stimulus (blink lab)
2. Using real world examples, predict responses to visual representations of a variety of external stimuli
3. Describe hormonal responses to scenarios that include internal and external stimuli
4. Investigate negative feedback systems involved in regulation of blood sugar levels
5. Investigate the physiology of exercise in order to explore circulation, respiration, and hormonal responses
6. Compare and contrast hypotonic, hypertonic, and isotonic solutions in the laboratory setting
7. Grow plants in order to observe tropisms
8. Demonstrate body processes using home-made models

TEKS Covered

7.6 Matter and energy. The student knows that matter has physical and chemical properties and can undergo physical and chemical changes. The student is expected to:

B) distinguish between physical and chemical changes in matter in the digestive system.

Supporting Standard-Category 1

C) recognize how large molecules are broken down into smaller molecules such as carbohydrates can be broken down into sugars.

7.12 Organisms and environments. The student knows that living systems at all levels of organization demonstrate the complementary nature of structure and function. The student is expected to:

B) identify the main functions of the systems of the human organism, including the circulatory, respiratory, skeletal, muscular, digestive, excretory, reproductive, integumentary, nervous, and endocrine systems. ***Supporting Standard-Category 4***

7.13 Organisms and environments. The student knows that a living organism must be able to maintain balance in stable internal conditions in response to external and internal stimuli. The student is expected to:

A) investigate how organisms respond to external stimuli found in the environment such as phototropism and fight or flight.

B) describe and relate responses in organisms that may result from internal stimuli such as wilting in plants and fever or vomiting in animals that allow them to maintain balance.

College Board Standards Covered

N/A

Vocabulary

cells, tissues, organs, organ system, circulatory system, respiratory system, skeletal system, muscular system, digestive system, excretory system, reproductive system, integumentary system, nervous system, endocrine system, stimuli, hormones, immune system responses, homeostasis, oxygen-carbon dioxide exchange, physiological, chemical digestion, mechanical

digestion, viral gastroenteritis, diffusion, osmosis, equilibrium, isotonic solutions, hypotonic solutions, hypertonic solution